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Patterns of Storm Injury and Tree Response

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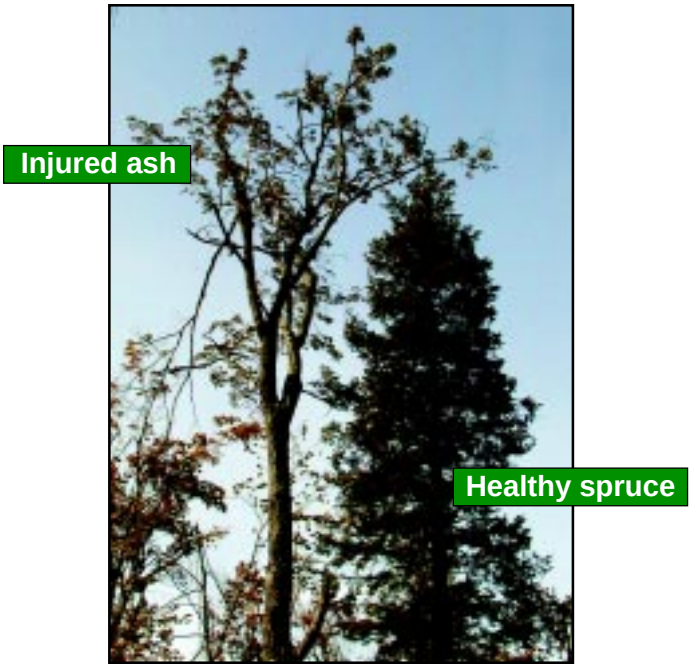
The ice storm of January 1998 in the northeastern United States and adjacent Canada was an extreme example of severe weather that injures trees every year. Broken branches, split branch forks, and snapped stems are all examples of storm injury.

Immediately following the storm, broken stems and hanging branches presented a safety hazard. In addition to safety, landowners and foresters were concerned about the amount of damage — defined as the loss of economic value of wood products — that would result from storm injury. In response to this concern about hardwood quality, we began a 5-year research program to identify patterns of storm injury and tree response to wounding.

During the first 2 years of research, we methodically dissected 40 hardwood trees that had been injured in the 1998 ice storm and earlier storms. Particular attention was given to wood discoloration and decay that would reduce the value of wood products. Because future storms are sure to occur, we hope these observations of injury and damage can help predict the effect of future storms on trees and wood quality.



Patterns of tree shape and position

In northeastern forests, the spreading branches of hardwood trees like maple, birch, and ash make them much more vulnerable to injury than softwood trees such as spruce, fir, and hemlock. Tree crowns at the edge of openings, in recently thinned stands, or those that are exposed above the adjacent forest canopy can be hit especially hard.

Patterns of injury and damage

Wood discoloration and decay are the largest sources of lost economic value of hardwood trees. Discoloration and decay are processes initiated by wounding and involve the injured tree, microorganisms, and the environment.

Any wound or break that exposes wood causes a defensive reaction in the tree and provides an opportunity for infection by microorganisms. Trees resist the spread of injury and infection through the process of compartmentalization. The details of compartmentalization vary among tree species. In all wounded trees, effective compartmentalization leads to relatively little loss of function and small amounts of discolored and decaying wood.

Broken branches are the most common form of storm-related injury. Branches that are broken high in the tree crown are not likely to initiate discoloration and decay in the main stem.

Small broken branches, limited defect

Discoloration that does spread into the bole from broken branches will tend to be in the central core of the tree, the least valuable portion for products. Extensive branch breakage in the outer crown can result in a significant loss of foliage and reduced growth.

Split fork on sugar maple

Split forks occur when one member of a twin or multiple stem is pulled and broken away from the remaining stem. Split forks can result in large wounds and extensive loss of foliage. Discolored and decayed wood associated with split forks is usually superficial, extending beyond the edge of the wound up to an inch or two along the length of the stem after 2 years.

Stem snaps occur when the entire trunk breaks in two. Stem snaps can cause a large wound to the remaining stem, often with extensive areas of torn bark and exposed wood.

Stem snap on paper birch

After 2 years, discolored and decayed wood in sugar and red maple, white ash, and American beech extend from a few inches to less than a foot along the main stem, beyond the base of the wound. Stem snaps in yellow and paper birch produce columns of discoloration and decay that extend several feet down the stem. These columns frequently join columns of discoloration initiated from previous injuries.

Indicators of damage severity

Similar wounds on different trees of a given species can produce widely different amounts of damage, estimated as loss of value of wood products.

Logging wound on yellow birch

Armillaria root disease on yellow birch

After the ice storm, the most severe damage was to trees with previous injuries to the lower trunk. Such injuries frequently result from logging or roadbuilding. Similarly, trees with previous root and butt infections such as Armillaria root disease were severely damaged.

Changes in tree form

New sprouts in ash

New sprouts may form near branch and stem breaks, producing a tufted appearance that frequently conceals wounds. New sprouts may also grow along the tree stem. Over several years, the potential added value from further growth may be reduced by changes in wood grain patterns caused by these epicormic branches.

Variation in tree injury and response

In surviving trees, all broken branches and stems are compartmentalized with varying degrees of effectiveness. The least effective compartmentalization and the greatest amounts of wood discoloration are in paper and yellow birch, with intermediate amounts found in red maple, and the least amounts of wood discoloration in sugar maple and white ash.

The greatest damage is in trees with previous injuries such as those caused by logging.

Compartmentalization is most effective for wounds located adjacent to a vigorous, healthy branch. Healthy branches supply energy to resist the spread of discoloration and infection.

In most cases, the progress of wood discoloration and decay in surviving trees is a slow process.

Damage (reduced product value of wood) depends on forest stand characteristics (species, tree density) and prior disturbance history (tree injury from machinery, root and butt disease, recent defoliation) as well as storm severity. Assessments of injury and predictions of damage require examining the whole tree, the remaining crown, and previous stem injuries and infections.

In conclusion, storm injury is a recurring feature in northeastern forests. Survival strategies of injured trees include sprouting to replace foliage and compartmentalization to resist the spread of infection. In surviving trees, reductions in wood quality and value frequently take years to develop. Trees at greatest risk for reduced value are those that have been previously injured, especially by wounding of the lower trunk.

Recovery of injured trees